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ABSTRACT

A method for processing a received, modulated pulse (*i.e.* waveform) that requires predictive deconvolution to resolve a scatterer from noise and other scatterers includes receiving a return signal; obtaining $L + (2M-1)(N-1)$ samples y of the return signal, where $y(\ell) = \tilde{\mathbf{x}}^T(\ell) \mathbf{s} + v(\ell)$; applying RMMSE

10 estimation to each successive N samples to obtain initial impulse response estimates

$[\hat{x}_1\{-(M-1)(N-1)\}, \dots, \hat{x}_1\{-1\}, \hat{x}_1\{0\}, \dots, \hat{x}_1\{L-1\}, \hat{x}_1\{L\}, \dots, \hat{x}_1\{L-1+(M-1)(N-1)\}]$; computing power estimates

$\hat{\rho}_1(\ell) = |\hat{x}_1(\ell)|^2$ for $\ell = -(M-1)(N-1), \dots, L-1+(M-1)(N-1)$; computing MMSE filters according to

$\mathbf{w}(\ell) = \rho(\ell) (\mathbf{C}(\ell) + \mathbf{R})^{-1} \mathbf{s}$, where $\rho(\ell) = |x(\ell)|^2$ is the power of $x(\ell)$, and $\mathbf{R} = E[\mathbf{v}(\ell) \mathbf{v}^H(\ell)]$ is the noise covariance matrix; applying the MMSE filters to y to obtain

15 $[\hat{x}_2\{-(M-2)(N-1)\}, \dots, \hat{x}_2\{-1\}, \hat{x}_2\{0\}, \dots, \hat{x}_2\{L-1\}, \hat{x}_2\{L\}, \dots, \hat{x}_2\{L-1+(M-2)(N-1)\}]$; and repeating (d)-(f) for subsequent reiterative stages until a desired length- L range window is reached, thereby resolving the scatterer from noise and other scatterers. The RMMSE predictive deconvolution approach provides high-fidelity impulse response estimation. The RMMSE estimator can reiteratively estimate the MMSE filter for each specific impulse response coefficient by mitigating the interference from neighboring coefficients that 20 is a result of the temporal (*i.e.* spatial) extent of the transmitted waveform. The result is a robust estimator that adaptively eliminates the spatial ambiguities that occur when a fixed receiver filter is used.

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